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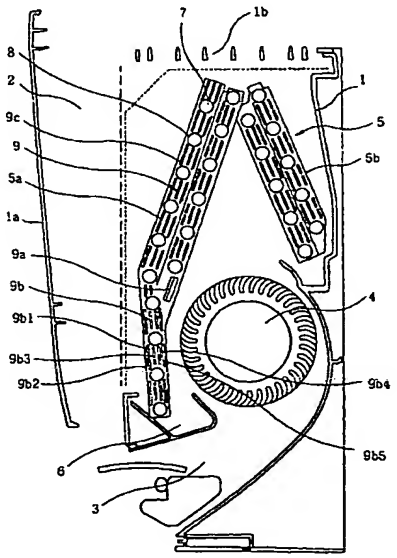
(54) Air conditioner

(57) An air conditioner includes a housing provided with one or more air suction openings and one or more air discharge openings; a cross flow fan disposed in the housing; and a fin attached heat exchanger unit disposed between the air suction openings and the cross flow fan and having a front heat exchanger, where a coolant tube is arranged in a lower portion of the front heat exchanger in a single row and in an upper portion thereof in two rows; and a rear heat exchanger, where the coolant tube is arranged in two rows, the front and rear heat exchanger being coupled in a substantially inverted "V" shape. A fin of the front heat exchanger is provided with a slit at a joint portion of the lower and upper portion thereof and a protrusion is formed at the slit to interfere with a suction air flow.

FIG. 1



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Description

[0001] The present invention relates to an air conditioner accommodating therein a fin attached heat exchanger.

[0002] For an indoor split-type air conditioner in particular, there has been an increasing demand for making a housing thereof more compact and thin to enable a more efficient use of the household space.

[0003] Conventionally, thinning of the housing has been achieved by reducing the housing dimension depth-wise. To this purpose, heat exchanger unit 15 is disposed between air suction opening 12 provided front surface 11a or top surface 11b of housing 11 and cross flow fan 14 installed within housing 11, as shown in Fig. 3. For example, there has been proposed an air conditioner with heat exchanger unit 15 including first heat exchanger 17 and second heat exchanger 18, wherein first heat exchanger 17 is disposed between front surface 11a of housing 11 and cross flow fan 14 such that it stands almost upright on drain pan 16, whereas second heat exchanger 18 is connected to an upper end of first heat exchanger 17 such that it is inclined toward a rear portion of housing 11 (see, for example, Japanese Patent Laid-open Application No. H9-210452). Here, second heat exchanger 18 is designed to be thicker than first heat exchanger 17.

[0004] In the conventional air conditioner, however, a velocity of air passing through a thin portion of the heat exchanger unit becomes greater than that of air passing through a thick portion thereof. Accordingly, an airflow velocity distribution over the entire area of the heat exchanger unit becomes non-uniform, which will, in turn, detrimentally affect the heat exchanging capacity of the heat exchanger unit. Further, since a portion of the heat exchanger unit close to the cross flow fan is thin and a velocity of air passing therethrough is substantial, noise in the form of abnormal sound (N · Z sound) may be generated during a normal operation of the air conditioner, wherein the abnormal sound is represented by multiplying a blade number Z of the cross flow fan by a rotation number N thereof.

[0005] It is, therefore, an object of the present invention to provide an air conditioner including a fin attached heat exchanger unit, capable of preventing its heat exchanging capacity from being deteriorated in spite of thinning the heat exchanger unit in order to compact a housing of the heat exchanger unit by configuring a coolant tube arranged in a portion of the heat exchanger unit in a single row, and capable of realizing an adequate operation sound without noise generation caused by abnormal sound (N · Z sound) during a normal operation of the air conditioner.

[0006] In accordance with a preferred embodiment of the present invention, there is provided an air conditioner including: a housing provided with one or more air suction openings and one or more air discharge openings; a cross flow fan disposed in the housing; and a fin attached heat exchanger unit disposed between the air suction openings and the cross flow fan and having a front heat exchanger, where a coolant tube is arranged in a lower portion of the front heat exchanger in a single row and in an upper portion thereof in two rows; and a rear heat exchanger, where the coolant tube is arranged in two rows, the front heat exchanger and the rear heat exchanger being coupled in a substantially inverted "V" shape, wherein a fin of the front heat exchanger is provided with a slit at a joint portion of the lower portion and the upper portion thereof and a protrusion is formed at the slit to interfere with a suction air flow.

[0007] The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical cross sectional view of an air conditioner in accordance with a preferred embodiment of the present invention;

Fig. 2A sets forth a detailed view of a slit in accordance with the present invention; and Fig. 2B illustrates a detailed view of another slit in accordance with the present invention; and

Fig. 3 shows a vertical cross sectional view of a conventional air conditioner.

[0008] Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings. Here, it is to be noted that the present invention is not limited thereto.

[0009] First of all, a fin attached heat exchanger in accordance with a preferred embodiment of the present invention will be described with reference to Fig. 1.

[0010] Fig. 1 is a cross sectional view of an air conditioner accommodating therein the fin attached heat exchanger in accordance with a preferred embodiment of the present invention.

[0011] As shown in Fig. 1, reference numeral 1 represents a box-shaped housing, housing 1 being provided with air suction openings 2 in its front surface 1a and top surface 1b, and air discharge opening 3 at its lower portion. Further, cross flow fan 4 is disposed at an inner lower portion of housing 1 and heat exchanger unit 5 is installed between air suction openings 2 and cross flow fan 4.

[0012] When viewed from the side of the vertical cross section of the air conditioner shown in Fig. 1, heat exchanger unit 5 includes front heat exchanger 5a installed on drain pan 6 and rear heat exchanger 5b connected to an upper end portion of front heat exchanger 5a and inclined toward a rear portion of housing 1, wherein coolant tube 7 is arranged in front heat exchanger 5a in different number of rows in a lower portion and an upper portion of front heat exchanger 5a: a single row in the lower portion and two or more, e.g., two rows in the upper portion, and wherein front and rear heat exchangers 5a and 5b are coupled in a substantially inverted "V" shape.

[0013] Heat exchanger unit 5 includes a number of fins 8 arranged in parallel to each other along a horizontal direction (i.e., along a direction approximately perpendicular to the paper of Fig. 1), and coolant tube 7 is configured such that it passes through fins 8 in a zigzag pattern.

[0014] Room air drawn into the air conditioner via air suction openings 2 by cross flow fan 4 is blown back out to the room through air discharge opening 3 after being cooled by heat exchanger unit 5.

[0015] With this configuration, by disposing coolant tube 7 in the lower portion of front heat exchanger 5a at a front side of cross flow fan 4 in the single row and by reducing a diameter of cross flow fan 4 which determines the dimension depth-wise of housing 11, a thinning of housing 1 can be achieved.

[0016] Although the thinning of housing 1 is achieved by the aforementioned configuration, a velocity distribution of heat exchanger unit 5 is non-uniform. That is, a velocity of air passing through the lower portion of front heat exchanger 5a provided with coolant tube 7 arranged in a single row (hereinafter, simply referred to as "single-row portion"), the air flow resistance of the lower portion of front heat exchanger 5a being small, is substantial and those of the air passing through the upper portion of front heat exchanger 5a provided with coolant tube 7 arranged in two rows (hereinafter, simply referred to as "two-row portion") and rear heat exchanger 5b with a small air suction area are small.

[0017] For the above-described reason, by providing a fin with slit 9a at a joint portion between the single-row portion and the two-row portion of front heat exchanger 5a and by forming protrusion 10 at slit 9a to interfere with a suction air flow, a velocity of the air passing through the joint portion can be reduced, resulting in the velocity distribution over the entire of heat exchanger unit 5 becoming uniform. At this time, one or two edges of slit 9a are connected to the protrusion, the protrusion being provided in the course of making the slit. Accordingly, as well as preventing the deterioration of the heat exchanging capacity of the heat exchanger as a whole, the noise in the form of abnormal sound (N · Z sound) is prevented from being generated during the normal operation of the air conditioner.

[0018] Further, as a consequence of protrusion 10 formed at slit 9a being the closest to cross flow fan 4 and being provided at the joint portion between the single-row portion and the two-row portion of front heat exchanger 5a to interfere with the suction air flow, the airflow velocity distribution can be improved to its maximum.

[0019] Moreover, the substantially great velocity of the air passing through the single-row portion of front heat exchanger 5a and the substantially small velocity of the air passing through the two-row portion thereof can be made uniform by making the number of slits 9b between two nearby passing portions of the coolant tube in the single-row portion of front heat exchanger 5a greater than that of slits 9c between two nearby passing portions of the coolant tube in the two-row portion thereof, i.e., by increasing a density of the slits between two nearby passing portions of the coolant tube, which will, in turn, improve the airflow velocity distribution and prevent the noise from being generated.

[0020] In the air conditioner in accordance with the present invention, a number of slits 9b are provided between the coolant tube in the single-row portion of front heat exchanger 5a, slits 9b1 to 9b5 with different heights are provided. For example, the heights of slits 9b1 and 9b2 are set to be 0.5 mm; the heights of slits 9b3 and 9b4 are set to be 0.7 mm; and the height of slit 9b5 is set to be 0.9 mm. With such configuration, the substantially great velocity of the air passing through the single-row portion of front heat exchanger 5a and the substantially small velocity of the air passing through the two-row portion thereof are made uniform. Accordingly, the airflow velocity distribution can be improved and noise generation can also be prevented.

[0021] Examples of detailed configuration of slit 9a are illustrated in Figs. 2A and 2B. Fig. 2A sets forth a detailed view of a slit in accordance with the present invention; and Fig. 2B illustrates a detailed view of another slit in accordance with the present invention. Further, a configuration of the slit is not limited to that of the slit in accordance with the present invention, for any slit with protrusion capable of interfering with the suction air flow will impart the same effect when used in the present invention.

[0022] In accordance with the preferred embodiment of the present invention, the housing of the air conditioner is compact and deterioration of the heat exchanging capacity over the entire heat exchanger unit is prevented by making the airflow velocity distribution over the entire heat exchanger unit uniform. In addition, the noise generation caused by the abnormal sound (N · Z sound) can be prevented. As a result, the present invention can be favorably applied to an air purifier or a dehumidifier.

[0023] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. An air conditioner comprising:

   a housing provided with one or more air suction openings and one or more air discharge openings;
   a cross flow fan disposed in the housing; and

a fin attached heat exchanger unit disposed between the air suction openings and the cross flow fan and including a front heat exchanger, where a coolant tube is arranged in a lower portion of the front heat exchanger in a single row and in an upper portion thereof in two rows; and a rear heat exchanger, where the coolant tube is arranged in two rows, the front heat exchanger and the rear heat exchanger being coupled in a substantially inverted "V" shape,
wherein a fin of the front heat exchanger is provided with a slit at a joint portion of the lower portion and the upper portion thereof and a protrusion is formed at the slit to interfere with a suction air flow.

2. The air conditioner of claim 1, wherein the fin is provided with a plurality of slits and the slit with the protrusion is closest to the cross flow fan among the plurality of slits.

3. The air conditioner of claim 1 or 2, wherein the number of slits between two nearby passing portions of the coolant tube in the lower portion of the front heat exchanger is greater than that in the upper portion of the front heat exchanger.

4. The air conditioner of any one of claims 1 to 3,
wherein multiple slits with different heights are provided between two nearby passing portions of the coolant tube in the lower portion of the front heat exchanger.

5. The air conditioner of any one of claims 1 to 4,
wherein the air suction openings are provided at a top part and a front upper part of the housing and the air discharge openings are disposed at a bottom part of the housing.

6. The air conditioner of any one of claims 1 to 5,
wherein one or two edges of the slit are connected to the protrusion, the protrusion being produced in the course of making the slit.

FIG. 1

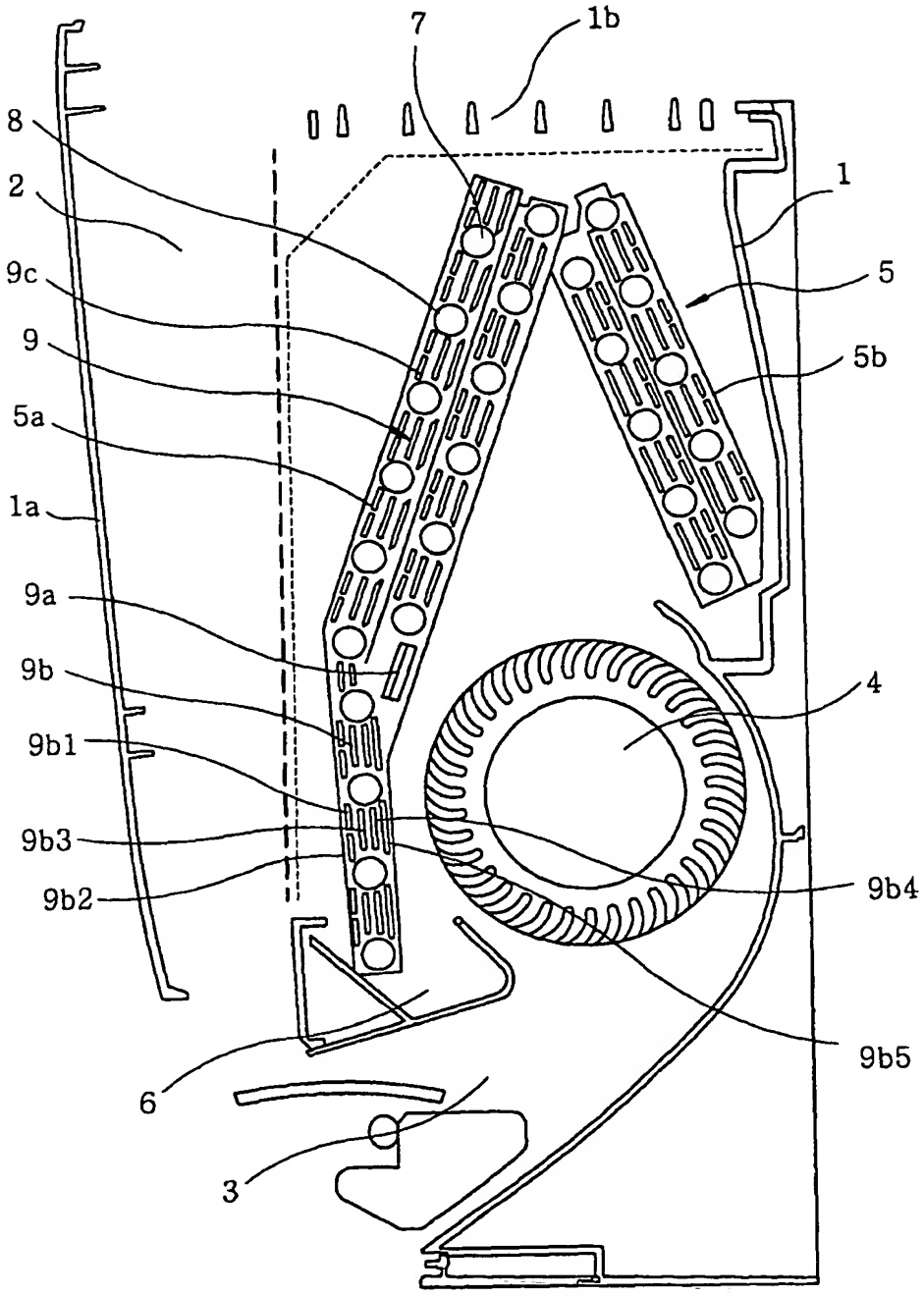

FIG. 2A

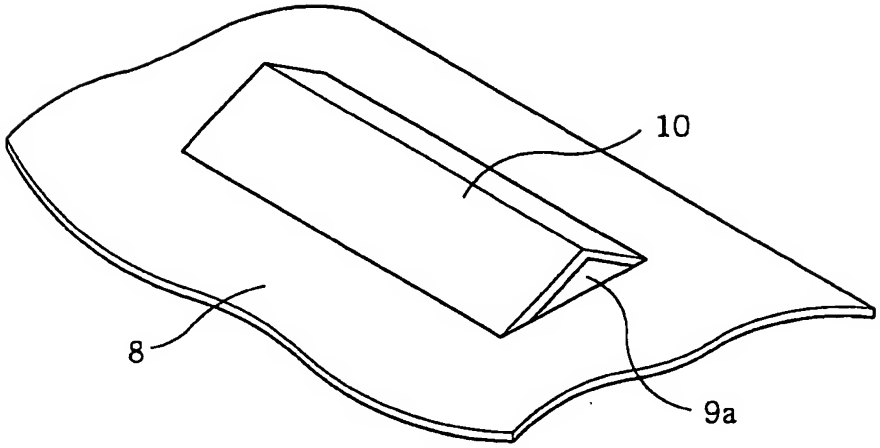

FIG. 2B

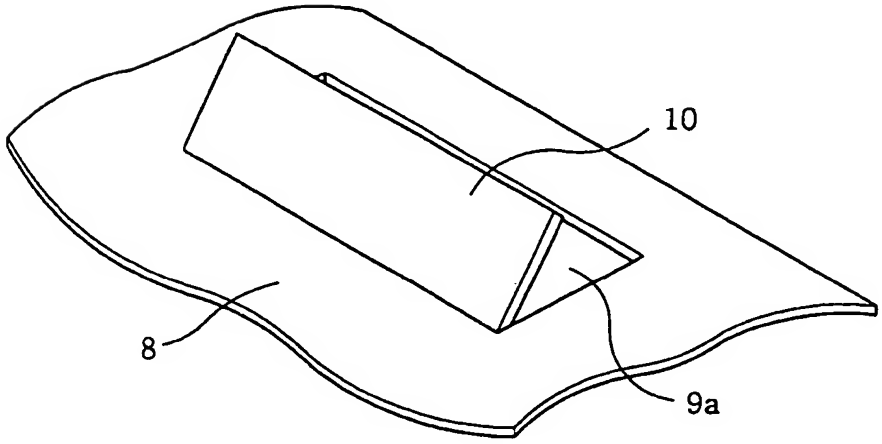

FIG.3

(PRIOR ART)